2014 SEI Research Review: Aligning Software Architecture and Acquisition Strategy

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Purpose of Our Research

Can we improve the probability of a program's success through a method, to be used by PMOs, that produces mutually constrained and aligned program acquisition strategy and software architecture?

Why this is important

- Software is increasingly important to the success of government programs.
- There continues to be little consideration of the software architecture in the development of either the system architecture or the program's acquisition strategy.
- Software architecture is often over constrained by decisions made early in the acquisition lifecycle when key program choices are being made – negatively affecting program success.

Alignment among the software and system architecture and acquisition strategy does not occur naturally

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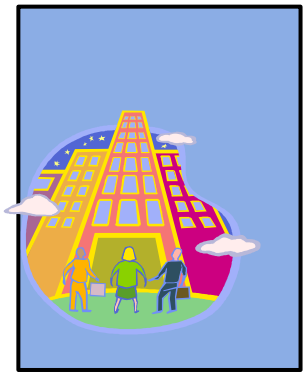
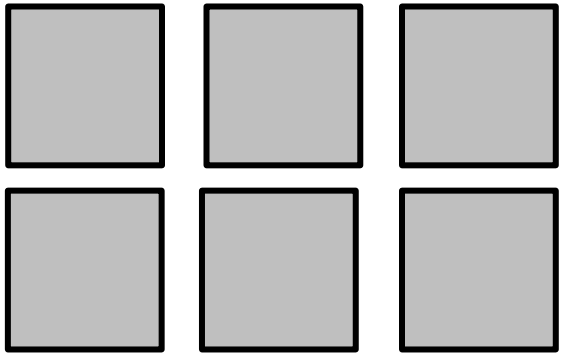
Interplay of Acquisition and Architecture



monolithic legacy architecture



new modular architecture with new and legacy capabilities

Program Manager

Should I have 1 contractor, or 2 or 3 or 6?

If 1 contractor, how do I enforce a modular architecture?

If multiple contractors, how do I ensure the parts fit together?

Can I migrate legacy to give me a quick delivery?

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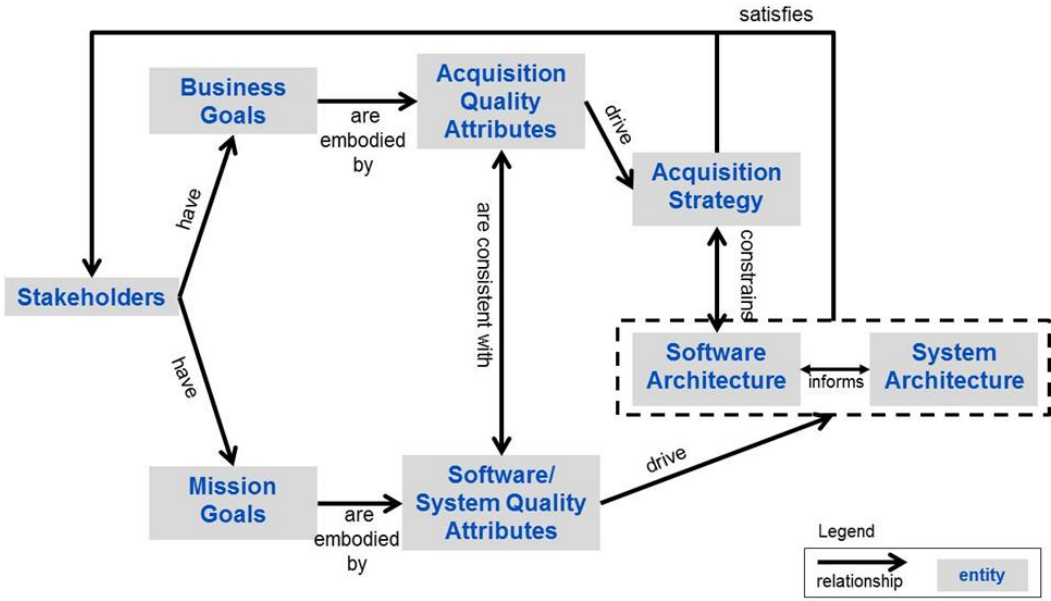
Phase 1 Research: Characterize Failure Patterns

Reoccurring patterns of failure

- Undocumented Business Goals
- Poor Consideration of Software
- Unresolved Conflicting Goals
- Failure to Adapt
- Turbulent Acquisition Environment
- Overlooking Quality Attributes
- Inappropriate Acquisition Strategies

Entities and relations: the way it should be



Phase 1 results published in SEI TN CMU/SEI-2013-TN-014:
"Isolating Patterns of Failure in Department of Defense Acquisition"

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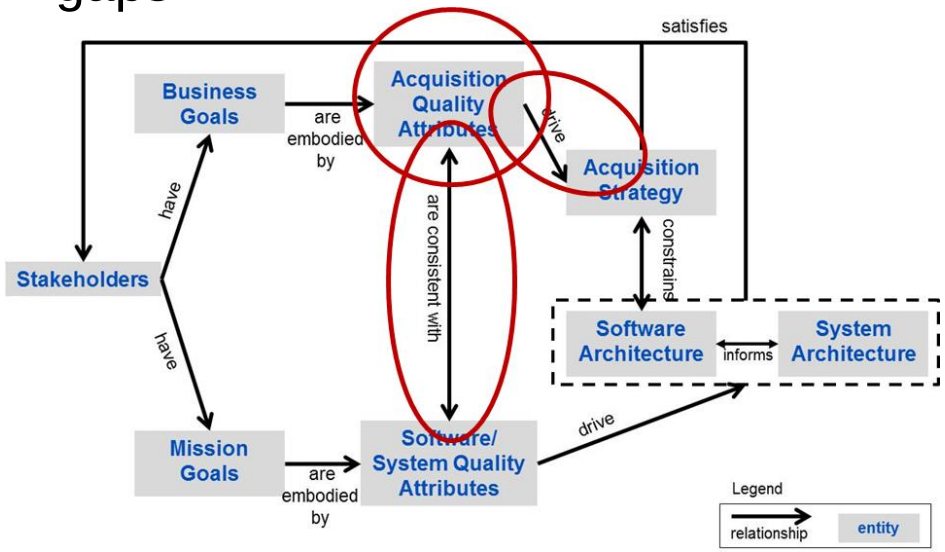
Phase 2 Research: Explore *Acquisition* Quality Attributes

Focus research to start filling the gaps



Captured 75 scenarios across 23 programs

- Identify candidate acquisition quality attributes (AQA)
- Determine how to express program-specific AQAs
- Construct AQA scenarios
- Analyze the scenarios
- Build a prototype workshop to elicit AQA scenarios

Phase 2 results to be published in SEI TN CMU/SEI-2013-TN-026: "Results in Relating Quality Attributes to Acquisition Strategies"

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Candidate Acquisition Quality Attributes (AQAs)

Original candidates

Acceptability	Competitiveness	Modifiability
Accountability	Contract manageability	Promptness in reporting problems
Affordability	Credibility	Responsibility
Appropriateness of contract	Effectiveness	Responsiveness
Appropriateness of technology	Evolvability	Sensibility
Achievability	Fairness	Staffability
Accreditability	Flexibility	Suitability
Balance	Implementability	Sustainability
Commitability	Legality	Timeliness
Communicability	Manageability of risk	Traceability with requirements
	Management visibility	

Sources: DoD acquisition strategy guidance and instruction documents

What our data showed

Acquisition Quality Attribute	Frequency
Flexibility	23
Performability	15
Realism	14
Affordability	10
Survivability	6
Executability	5
Responsiveness	4
Programmatic Transparency	2
Innovativeness	1
Schedulability	1

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Acquisition Quality Attribute Scenarios

Expressing AQA scenarios similarly to software QA scenarios is a viable path

Software QA Scenarios	Acquisition QA Scenarios
Software architecture	Acquisition strategy
System	Program
Architect	Program manager

Scenario from software domain:

Stimulus: An internal component fails

Environment: During normal operation

Response: The system is able to recognize a failure of an internal component and has strategies to compensate for the fault

Scenario from acquisition domain:

Stimulus: An unexpected budget cut

Environment: For a multi-segment system

Response: The program is able to move work between major segments to speed up or slow down separate segments within the available funding

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What can AQA scenarios tell us?

Fundamentally, AQA scenarios can be used to

- Express business and mission goals in a way that directly influences the acquisition strategy
- Determine the appropriateness of the acquisition strategy with respect to any given scenario

Specifically, 3- and 6- part AQA scenarios can be used to identify possible incompatibilities between

- AQA scenarios
- Software QA scenarios and AQA scenarios

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Incompatibilities between Scenarios

Stakeholder A: advocates use of open source software as a means of increasing responsiveness to users

Stimulus	Users request significant new functionality to be delivered rapidly
Environment	during the program's development phase
Response	create the functionality rapidly by reusing open source and software from other projects to provide much of the capability.

Stakeholder B: is responsible for ensuring that the deliverables meet rigorous safety standards

Stimulus	A new requirement to adhere to a rigorous safety standard is applied to the system
Environment	during the program's development phase
Response	The developers remove all unreachable code to insure that the system will pass stringent new certification standards.

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Prototype Elicitation Workshop

Adapted the QAW for eliciting software quality attributes

- Greater emphasis on the business goals and objectives presentation
- Replaced the architecture presentation with an acquisition strategy and plans presentation

Conducted the prototype on a real program using SEI staff that were supporting the program

- Generated 20 acquisition QA scenarios

Acquisition Quality Attribute	Scenario	Potential Acquisition Tactic
Flexibility	The user's system requirements change radically 30 days before the RFP is released when the "go live" date is fixed; the RFP is released regardless.	Establish fallback strategies that protect the "go live" date.
Affordability	We discover that the cost of operating the system will be higher than the ceiling mandates during development but before initial fielding; the system (including its architecture) is shifted to a less costly alternative.	Emphasize the need for architecture adaptability and flexibility.

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Phase 3: Develop and Pilot an Alignment Method

Research questions that are focusing our work this year

- Can business goals that represent the full range of program stakeholders be explicitly defined and prioritized?
- Will having a more complete, explicit set of business goals generate a more complete set of AQA scenarios?
- Will reconciling Acquisition QA scenarios and Software QA scenarios lead to mutually constraining acquisition strategy and software architecture?
- Will a method that aligns Acquisition QAs and Software QAs be useful to a program?

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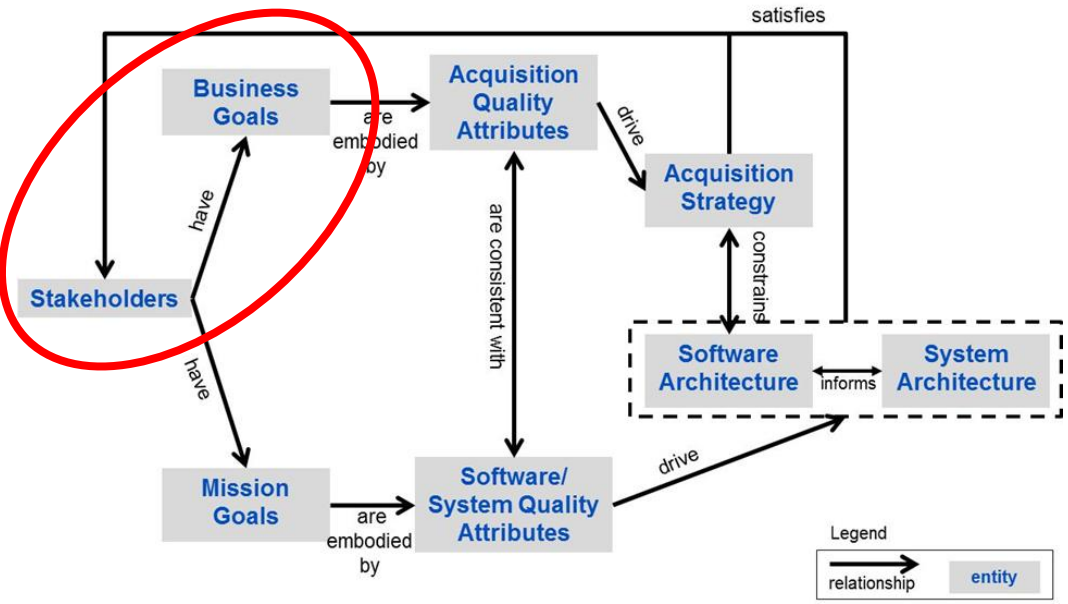
Phase 3 Research: Work to Date in FY14

Business Goal Determination



*Business Goal Scenarios found in SEI TN CMU/SEI-2010-TN-018: "Relating Business Goals to Architecturally Significant Requirements for Software Systems"

Focus on capturing business goals

- Identify stakeholders
- Elicit business goals
- Represent goals in standard form*

Analyze goal subjects and objects to identify additional stakeholders

Expect the PM to carry this out

Probably applies to Mission Goal elicitation

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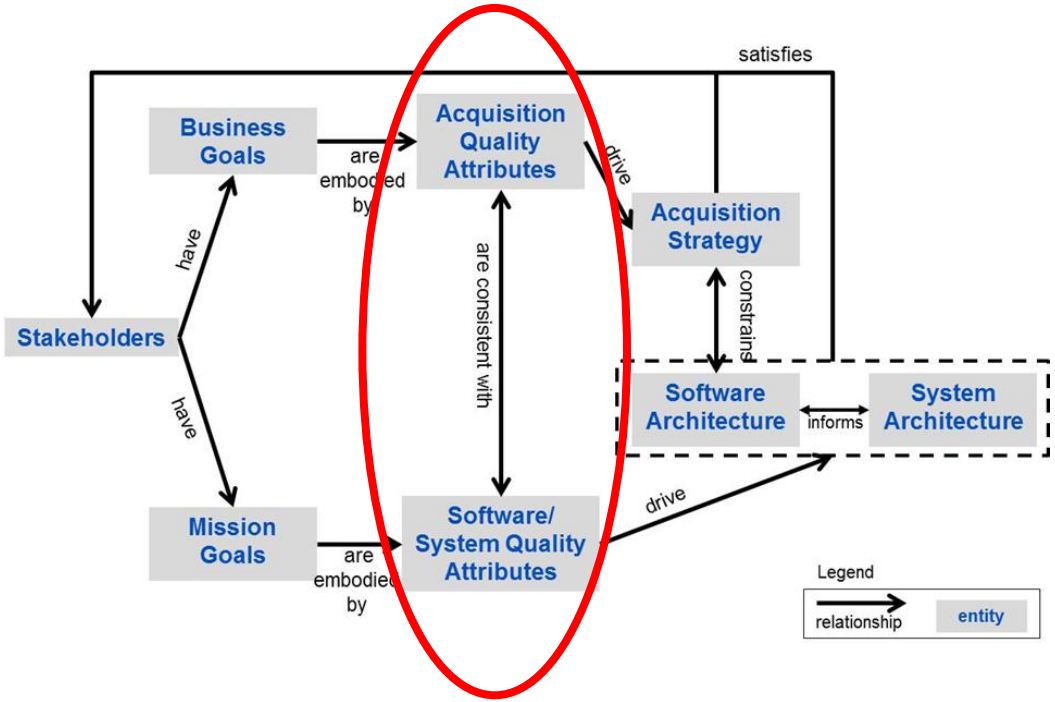
Phase 3 Research: Work to Date in FY14

Quality Attribute Consistency



Focus on consistency of scenarios

- Just beginning this work

Hypotheses

- Needs reasonably complete scenarios
- Will require feedback to stakeholders if goals have to be modified
- Performed by PM and evaluation team

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Conclusion

We’re making progress

There is more work that could be added to this year’s effort

- An assessment instrument
- Metrics

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